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## **Contributions of Chakrapanidatta for the Advancement of Science w.s.r. to Rasasastra, the Iatrochemistry of Ayurveda**

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### **Abstract:**

Ayurveda is a holistic life science and covers all aspects of human life. Positive diet regimen and life style provides healthy physico-mental status. Due to close proximity of man with nature herbs and animals are initially identified for both drug and diet. Later minerals and metals were also into existence for therapeutic use. During Samhita period, usage of metals and minerals was limited. In due course, with the development of processing techniques, mineral and metallic preparations became frequent in Ayurvedic therapeutics especially during medieval period.

Chakrapanidatta belongs to 11th AD, composed a text book on medicine entitled 'Chikitsa Sangraha'; commonly known as 'Chakradatta'; set a historical land mark in the development of medical principles in India during medieval period. The author incorporates the advances in medicine during two centuries after Vrinda's Siddhayoga. The period is characterized mainly by the evolution of Rasasastra. In comparison with the other medieval works, Chakrapani has revealed number of mercurial preparations for the management of various disorders. Along with Parada (mercury), other groups of drugs such as Maharasa, Uparasa, Sadharanarasa, Dhatu, Ratna and Sudha Varga are also traced in Chakradatta. It is observed that 'Rasaparpati' is described by Chakrapani for the first time and incorporated in the formulary of Ayurveda.

On a critical study it is observed that Chakrapani has undoubtedly contributed a lot for the advancement of science especially to Rasasastra, the iatrochemistry of Ayurveda.

Key words: Chakrapani, Ayurveda, Rasasastra, Iatrochemistry

## **Introduction:**

### **Introduction:**

Chakrapanidatta composed a text book on medicine entitled &ldquo;Chikitsa Sangraha&rdquo; commonly known as Chakradatta presumably on the authors name as Rigvinischaya of Madhavakara become popular as Madhavanidana . This work set a historical land mark in the development of medical principles in India. Nischalakara (13th Century AD) wrote an exhaustive commentary on Chakradatta entitled as Ratnaprabha. Basing on the information furnished by the author himself at the end of the treatise; Shivadas Sen interpreted that Chakrapani belongs to Lodhravali family. His father Narayanadatta was kitchen superintendent during the period of Gouda king Nayapala and his brother Bhanudatta was court physician. Most of the historians fixed the period of Chakrapanidatta as 11th century AD. A verse at the end of Chakradatta clearly indicates that he followed the text of Vrinda&rsquo;s Siddhayoga clearly suggests that this work is considered as post Vrinda treatise. According to Nischalakara, it is known that he has traced the sources of many verses of Chakradatta are from as many as 49 works of preceding authors viz. Charaka, Susruta, Harita, Bhela, Kharanada, Krishnatreya, Videha, Ksharapani, Nagarjuna, Vagbhata, Chandrata, Ravigupta, Vrinda etc.

### **Aims & Objectives:**

- To study Chakradatta critically and screen each and every metallic and mineral substance. - To document the indications of various metals and minerals in different disease conditions. - To record the replication number of all the metals and minerals for finding out their utility in specific conditions.

### **Material & Methods:**

The English translation of Chakradatta by Acharya P.V. Sharma along with the commentaries of Nischalakara and ShivadasSen has been taken into consideration as the source for this present study. A thorough analysis has been done to enumerate simple recipes and compound preparations containing metals and minerals. The replication number of each and every drug was also recorded to find out the utility of that drug in the specific condition.

### **Observations:**

Along with plentiful of herbs and animal products, the following metals and minerals related to various groups such as Maha-rasa, Upa-rasa, Sadharana-rasa, Dhatu, Ratna, Sudha varga etc. also have been traced in Chakradatta.

The number mentioned against each substance indicates its replication.

Table no. 1 Showing the Metals and Minerals of Chakradatta

S.No.	Category	Name of the Metal Mineral	No. of times mentioned
	Rasa	Parada(Mercury)	19
	Maharasa	Abhraka (Mica)	07
	Makshika (Copper pyrite)	09	
	Shilajatu (Bitumen)	22	
	Tuttha (Copper sulphate)	06	
	Uparasa	Gandhaka (Sulfur)	18
	Gairika (Red oxide of iron)	31	
	Kasisa (Ferrous sulphate)	09	
	Sourashtri (Alum)	02	
	Talaka (Arsenic trisulphide)	26	
	Manahshila (Arsenic disulphide)	41	
	Anjana (Antimony sulphide)	09	
	Sadharana Rasa	Varata (Cowrie shell)	04
	Sindura (Lead peroxide)	05	
	Dhatu	Swarna (Gold)	11
	Rajata (Silver)	08	
	Tamra (Copper)	15	
	Loha (Iron)	59	
	Naga (Lead)	05	
	Vanga (Tin)	02	
	Kamsya (Bronze)	04	
	Pittala (Brass)	02	
	Mandura (Fe <sub>2</sub> O <sub>3</sub> )	26	

	Ratna	Mukta (Pearl)	05
	Pravala (Coral)	03	
	Vaidurya (Cat's eye)	02	
	Sudha varga	Sukti (Pearl Oyster)	04
	Sankha (Conch shell)	31	
	Khati (Chalk)	01	
	Sambooka (Small sized conch)	05	
	Samudraphena (Cuttlefish bone)	11	
	Tankana (Boric acid)	05	

## Parada

### 1. Parada (Mercury):

- Overall 19 references related to Parada are available in Chakradatta and it is indicated in 14 different conditions such as Grahani(dysentery), Arshas(hemorrhoids), Agnimandya(anorexia), Krimi(worm infestations), Yakshma(wasting condition), Amavata(rheumatoid arthritis), Parinamasoola(colic during digestion), Amlapitta(hyperacidity), Balaroga (diseases of children), Rasayana(rejuvenation therapy) and Vajikarana(aphrodisiacs)etc. - It is identified that Rasaparpati is introduced in the formulary of Ayurveda by Chakradatta for the first time[1]. - Purificatory measures[2] as well as preparation of Kajjali [3]are also mentioned by the author in this compendium. - Rasaparpati, Rasa-Gudika, Brihat-Simhanada GugguluandBrihat Lokanadha Rasaetc. are some of the important compound recipes useful for the management of Grahani, Arshas, Amavata and Pleeha-Yakrit (splenomegaly and hepatomegaly) respectively.

### 2. Abhraka (Mica):

## Abhraka

In total 7 references are noticed in this work and is indicated in Arshas, Agnimandya, Pleeha-Yakrit, Rasayana etc.

- Purification [4] and incineration processes of mica[5] are mentioned in the chapter of Amlapitta and Rasayana. -

## Makshika

Rasa-Gudika, Paniyabhakta Gudika, Brihat Lokanadha Rasa and Shadanga Tamrayoga are the compound preparations related to Abhraka and are prescribed for the management of Arshas, Agnimandya, Amlapitta and as a Rasayana respectively.

### **3. Makshika (copper pyrites):**

- Both types of Makshika viz. Swarnamakshika and Roupamakshika are mentioned by the author and in total 9 references are identified. - Makshika is useful for the management of Pandu (anemia), Raktapitta (hemorrhagic disorder), Yakshma, Prameha (urinary disorders and diabetes), Amlapitta and Netraroga (diseases of the eye). - Yogaraja is considered as the best recipe for the management of Pandu [6] and hence it is quoted in almost all medieval works. - Tryushanadi Mandura, Khandakadya Loha and Tapyadi Loha are the popular compound formulations of Makshika indicated in Pandu, Raktapitta and Yakshma roga respectively.

#### **- Shilajatu (Bitumen):**

### **Shilajatu**

On the whole 22 references related to Shilajatu have been identified and it is indicated in various conditions like Arshas, Pandu, Raktapitta, Yakshma, Mutraghata (retention of urine), Mutrakricchra (dysuria), Ashmari (calculus), Prameha, Sthoulya (obesity) and also as Rasayana.

- Shilajatu can be considered as the best Rasayana and is very much useful for the management of urinary disorders including Prameha. - Identification, examination, features of the best variety of Shilajatu along with the purificatory measures has been delineated by the author comprehensively in the chapter of Rasayana [7]. - Regular use of Shilajatu, Mutra, Guggulu, Triphala and Snuhi kshira relieves Udara roga (abdominal disorder) [8]. - Intake of Shilajatu with Agnimandha Quadha alleviates obesity [9]. - Shilajatu mixed with the decoction of Virataradi gana dravya or the decoction of Duralabha or Vasa is useful for the management of retention of urine [10]. - Intake of Shilajatu or Guggulu along with Gomutra (cow's urine) relieves Kaphaja Pandu [11]. - Internal administration of Shilajatu Bhasma taken with honey relieves diabetes [12].

### **Tuttha**

#### **Tuttha (Copper sulfate):**

- Tuttha is mentioned in 6 places and is indicated for the management of Vranasodha (inflammation), Bhagandara (fistula in ano), corneal opacity and alopecia areata. - In all these conditions Tuttha is used as an external application only. - Jatyadi Ghrita is the best recipe for the management of chronic wounds and ulcers [13]. - Akshipurana with Tuttha dissolved in water alleviates Sukra (corneal opacity) [14].

### **6. Gandhaka (Sulfur):**

## Gandhaka

Overall Gandhaka is traced in 19 places and is indicated in 11 different conditions like Grahani, Krimi, Yakshma, Amavata, Kushta, Rasayana etc.

- Gandhaka is considered as the drug of choice for the management of skin disorders and it can be used both externally as well as internally. It is also useful as Rasayana. - Purificatory process of Gandhaka is also documented by the author in a lucid manner [15]. - External application of Gandhaka mixed with mustard oil relieves Sidhma kushta [16]. - Vidanga Taila. Simhanada Gugguluand Brihat-Satavarimanduraare the compound formulations are useful for the management of Krimi, Amavata and Parinamasoola respectively. - Shadanga Tamrayogaand Saptanga Tamrayoga are the best rejuvenators quoted by the author in the chapter of Rasayana[17].

## Gairika

- **Gairika(Red oxide of iron):** - In total,31 references related to Gairika have been traced in the entire compendium. Among those 31, maximum numbers of references i.e. 11 are identified in Netraroga Chikitsa only. - Gairika is useful for the management of Hicca(hiccup), Kamala(jaundice), Asrigdara (menorrhagia and metrorrhagia) and Mukhapaka (stomatitis) etc. - Gairika is mentioned as Lepa (external application) and as Anjana (collyrium) in huge number of places and it is also prescribed for internal administration. - Powder of Haridra, Gairika and Amalaki applied as collyrium also relieves jaundice[18]. - Katukarohini and Swarna-Gairika mixed with honey relieves hiccup [19]. - External application of Gairika mixed with ghee alleviates Pittaja Visarpa(erysipelas)[20]. - Anjanaprepared with Dakshanda twak, Manahshila, Sankha, Kacha, Chandana and Gairika acts as scarifying agent (Lekhana) in corneal opacity, pterygium etc. [21] - Intake of the powder of Swarna-Gairika mixed with honey gives quick relief to the child suffering from hiccup[22] - External application of the paste prepared by pounding Darvi, Mustha and Gairika with goat's milk is beneficial for the management of eye disorders in children[23]. - **Kasisa (Ferrous Sulphate):**

## Kasisa

Kasisa is identified in 9 places and is indicated in Hicca-Swasa(hiccup & dyspnea), Kushta(skin disorders), Indralupta(alopecia areata)and Netraroga.

- It is also useful for both external and internal purposes. For the management of Sirotpata (epi-scleritis) and Siraharsha (allergic hyperemia of the eyeball) it is used as collyrium. - Intake of Kasisa Bhasma andKapittha(wood apple) mixed with honey relieves hiccup[24]. - Collyrium prepared with Saindhava(rock salt) and Kasisa pounded with Sthanya (breast milk) is also useful for the management of Sirotpata [25]

## Sourashtri

### 9. Sourashtri (Alum):

- Only two references are traced in the entire text book of Chakradatta, one in Visha Chikitsa and the other in Netrarogadhikara. - Mritasanjivani Agada, which was initially formulated by Lord Brahma can be used as Nasya (snuff) , Lepa (external application), Dharana (amulet) and Dhumapana (medicated smoking) for the management of poisoning as well as evil spirits[26].

## **- Talaka (Arsenic trisulphide):**

### **Talaka**

Talakais traced at 26 places and is indicated in 13 disease conditions viz. Arshas, Kasa(cough), Bhagandara, Kushta, Kshudraroga(minor diseases), Netraroga and Putikarna (fetid discharge from the ear)etc.

- Talaka can be considered as the drug of choice in the management of complicated skin disorders and it is also acts as depilatory agent when applied externally after mixing with Sankha Bhasma. - Karnapurana with Haritala mixed with Gomutra is useful for the management of Putikarna[27] - External application of the paste of Apamarga moola Kshara mixed with Talaka destroys penile warts [28]. - Application of the paste prepared by pounding Talaka with cow's milk alleviates bad odor emits from axilla etc.[29] - **Manahshila (Arsenic disulfide):**

### **Manahshila**

Manahshila has been traced in 41 places and stood the next best in its replication after Loha (iron).

- Among those 41 references maximum numbers of references are available in Netraroga and Kushta only. The other conditions are Jwara(fever), Kasa, Apasmara(epilepsy), Galaganda(goiter), Indralupta and Visha roga (complications of poisoning) etc. - For the management of Kasa, the drug Manahshila is used in the form of Dhumapana[30]. - Manahshiladi Lepa, Nisa-Manahshila Taila and Brihat Marichadi Taila etc. are popular formulae for the management of Kushta. - Chandrodaya Varti, Sankhadi Varti and Kasisadi Rasakriyaare the important recipes containing Manahshila and are useful for the management of cataract, night blindness and pterygium etc.

### **Anjana**

#### **Anjana (Antimony sulfide):**

- Overall9 references related to Anjanaare available in Chakradatta and it is indicated in 5 different conditions such as Netraroga, Hicca, Arshas, and Sthoulyaetc. - Regular use of Souveeranjana (Antimony sulfide) as collyrium is excellent for protecting eyes [31]. - Varti prepared by pounding Vyosha, Loha Bhasma, Sindhuttha, Triphala and Souveeranjana with water alleviates cataract[32]. - Application of collyrium with Souveeranjana mixed with honey and ghee alleviates Sirotpata(epi-scleritis)[33].

Kampillaka

**Kampillaka (Mallotus philippinensis):**

- Kampillaka is traced in 12 places and is indicated in 8 different conditions like Jwara, Krimi, Soola(colic), Udavarta (oppression of the chest or abdomen), Gulma(abdominal tumor), Prameha, Udara and Vranasodha. - Ashtadasanga Quadha, Vidangadi Kalka, Triphala Ghrita, Dhanvantari Ghritam, Patoladi Churna, Durvadi Tailaetc. are the compound formulae containing Kampillaka.

**Varatika**

**Varatika (Cowrie shell):**

- Varatikais traced in 4 places such as Pleeha-Yakrit, Bhagna(fractures), Netraroga and Balaroga. - Intake of Pita Varatika Churna in a dose of 2 to 3 Gunja (250-375mg) with un-boiled milk (Apakwa kshira) promotes the union of fractured bone[34]. - Brihat Lokanadha Rasa is one of the compound drug formulae containing Varatika and is indicated for the management of splenomegaly, edema and anorexia[35].

**- Sindura (Lead oxide):**

**Sindura**

Sindura is mentioned at 5 places and it is indicated in Vranasodha, Kushta and Kshudraroga.

- Sinduradi Lepa and Taila are most commonly used for the management of wounds and skin disorders[36]. - ViparitaMalla Tailais useful for the management of Dushtavrana(chronic wounds), Abhighataja Vrana(accidental injury), Upadamsa(syphilis), Nadivrana(sinus)etc.[37]

## - Swarna (Gold):

### Swarna

Altogether 11 references related to Swarna are available in Chakradatta.

- Swarna Bhasma is useful for purification of female reproductive system and prepares suitable ground for providing conception if administered internally along with ghee[38]. - Gold is also useful for fabricating various types of instruments like Vasti-netra[39], Dwimukha-nadiyantra[40] and Anjana Salaka [41] etc. - Small male idols of God prepared with gold, silver or iron are heated red hot and immersed in milk, curd or water. Intake of such milk or curd or water handful during Pushya Nakshatra provides male progeny[42]. - Seed of Brihat Karanja is filled with Parada (mercury) and covered with gold (HemnaSuveshtitam). Keeping this in mouth retains semen[43].

### Rajata

#### Rajata (Silver):

- 8 References related Rajata are traced in this work. - Similar to gold, silver also can be used for fabrication of Vasti-netra, Anjana Salaka etc. - Application of collyrium (Anjana) prepared by pounding Pravala, Mukta, Vaidurya, Sankha, Sphatika, Chandana, Suvarna, Rajata and Kshoudra alleviates Suktika (xerophthalmia).

#### - Tamra (Copper):

### Tamra

Altogether 15 references of copper are traced in this compendium.

- Copper is also useful for fabrication of vessels and other instruments like Vasti netra, Anjana Salaka etc. - Tamrayoga mentioned in Grahani roga is to be taken in the form of Vardhamana Kalpa and is useful for the

management of Grahani, Amlapitta, Kshaya and Soola. It is also useful for increasing the digestive fire as well as promoting strength and luster.[44] - Tamra can be used as collyrium for the management of eye diseases[45]. -

## Loha

Induce vomiting by means of Tamra Bhasma mixed with honey to alleviate artificial poisoning[46]

- **Loha (Iron):** - Loha stood first among all the metals and minerals of Chakradatta in its replication number as 59. It is indicated in more than 15 disease conditions such as Arshas, Pandu, Raktapitta, Soola, Parinamasoola, Amlapitta and Netraroga etc. - More than 10 references of Loha are traced in both Panduroga and Parinamasoola. It is also considered as best Rasayana Dravya. - Purificatory[47] and incineration techniques of Loha [48] have been described by the author in a lucid way. - Intake of Loha Bhasma along with Sunthi powder alleviates Kaphaja Pandu[49]. Similarly Loha Bhasma impregnated with Gomutra for 7 days and taken internally along with milk alleviates Panduroga[50]. - Powder of Loha Bhasma, Haritaki and Haridra mixed with honey and ghee alleviates jaundice[51]. - Application of the paste of Loha Bhasma, Kasisa and Triphala kusuma restores the normal complexion of the skin[52] - Iron is also mentioned for fabricating Vasti-netra as well as Anjana Salaka. - Agnimukha Loha, Navayasa Churna, Yogaraja, Vidangadi Loha, Dhatri-loha, Triphala Loha and Saptamrita-Loha etc. are some of the important compound formulations of iron.

Vanga

Naga

Pittala

## **Naga (Lead):**

- Naga is identified in 5 places. Among them 2 references are related to Netraroga, two are Arbuda (tumor) and the other one belongs to Kshudraroga. - Sisa(lead) is to be pounded with sour gruel and then mix Sankha Bhasma. Application of such paste followed by covering the scalp with Arka leaves results in blackening of grey hair [53] - Fomentation with Snuhi (stem pieces), Sisa(lead pieces), Lavanaor Pindaraka phala alleviates Arbuda[54].

- **Vanga (Tin):** - Only 2 references related to Vanga (tin) are traced in this work. - Along with other metals Vanga is also mentioned for the fabrication of Vasti-netra[55].

- **Kamsya (Bronze):** - Altogether 4 references of Kamsya (bronze) are traced in Sooladhikara, Balaroga, Sweda (sudation therapy) and Vasti Vidhi(enema therapy). - Fomentation with heated Kamsya (bronze and other metallic appliances) is known as Tapa Sweda[56]. - Kamsya is also useful for fabrication of Vasti-netra.

- **Pittala (Brass):** - Brass is traced only at 2 places viz. in the chapters of Anuvasanavasti and Rasayana. - It is not indicated either for internal administration or as an external application. - It is mentioned for the fabrication of vessels as well as instruments such as Vasti-netra.

## **Mandura**

- **Mandura (Fe<sub>2</sub>O<sub>3</sub>):** - Overall 26 references related Mandura have been traced in 7 different conditions like Agnimandya, Pandu, Soola, Parinamasoola, Galaganda, Kushta, Amlapitta and Palita(premature graying of hair). - Among those 26; nearly 50% of the references are identified in the chapter Parinamasoola and 20% in Panduroga. - Purificatory process of Lohakitta (Mandura) is mentioned in the chapter of Amlapitta vide quotation number 33 and 34. - Lohamala (Mandura) is to be kept in a vessel containing Mahisha mutra (buffalo's urine) for one month and then burnt by closed heating (Antardhumavidagdham). Intake of such Bhasma mixed with honey relieves Galaganda[57]. - Tryushanadi Mandura, Punarnavadi Mandura and Mandura Vajra Vataka are the best compound recipes useful for the management of Pandu. - Similarly Triphala Mandura, Koladi Mandura, Bhimavataka Mandura, Chavikadi Mandura, Satavari Mandura etc. are the popular recipes available in this treatise for the management of Parinamasoola. - Regular application of the paste of Mandura, Amalaki and Japa pushpa on the scalp followed by head bath prevents premature graying of hair[58].

## **Mukta**

### **Mukta (Pearl):**

- Mukta is traced at 5 places in the 3 chapters viz. Murcha, Netraroga and Swasthyadhikara. - Wearing necklaces of pearls and other precious gems is wholesome for the patients suffering from Murcha(syncope) [59]. - Similarly it is advised that one has to wear pearls and gems and should relax comfortably on a chair or bed with sufficient cooling agents viz. fans, touch of hand and sandal etc. during summer season[60]. - Mukta is one of the ingredients in Dantavarti and Pravaladyanjana useful for the management of corneal ulcer and

xerophthalmia respectively when applied as collyrium[61].

## **Pravala**

### **Pravala (Coral):**

- Pravala is traced at 3 places only. Among them 2 are from the chapter of Netraroga and one from Mutrakricchra. - Intake of Pravala-pishti along with rice water alleviates dysuria caused by Kapha[62]. - Pravala is one of the ingredients in Srotojadi Varti and Pravaladyanjana and are useful for good vision and xerophthalmia respectively when applied as collyrium[63].

## **Vaidurya**

### **Vaidurya (Cat's eye):**

- Vaidurya is traced at 2 places and that too both are in the same chapter viz. Netrarogadhikara. - Meshasringyadi Varti and Pravaladyanjana are the 2 collyrium recipes useful for good vision as well as xerophthalmia[64].

- **Sukti (Pearl Oyster):**

## **Sukti**

Sukti is identified at 4 places in the chapters of Pleeha-Yakrit, Visarpa, Vranasodha and Yonivyapath.

- The Kshara prepared from pearl oyster obtained from sea taken internally along with milk relieves Pleeha[65]. - Dusting the powder of Sukti mixed with Panchavalkala churna promotes the process of wound healing[66]. - Sukti is one of the ingredients in Kshara Taila and is useful for the management of venereal diseases, hemorrhoids and skin diseases. This recipe is also considered as one of the best depilatory agent[67].

- **Sankha (Conch shell):** - Sankha (conch shell) is traced at 31 places and is useful in 12 different conditions like Soola, Palita, Visarpa, Netraroga, Yonivyapath and Balaroga etc. -

### **Sankha**

Among those 31 references, nearly 50% are identified in the chapter of Netrarogadhikara only.

- External application of the paste of Vasa patra rasa or Bilwa patra rasa mixed with Sankha Bhasma relieves foul smell emits from the body[68]. - External application of the paste of Sankha and Saivala mixed with ghee relieves Pittaja Visarpa[69] - Lepa with Sankha churna mixed with Mulaka kshara alleviates Kaphaja Arbuda[70] - Intake of the powder of Sankha bhasma, Saindhavalavana, Hingu and Trikatu along with hot water relieves colic caused by all the 3 Doshas[71]. - Sankha bhasma is also used as depilatory agent when applied externally after steeping with Kadali Swarasa and mixed with equal quantity of Haritala[72]. - Sankhadi Varti, Saindhavadi Varti, Danta Varti, Chandrodaya Varti, Pravaladyanjanataetc. are some of the important compound recipes containing Sankha and are useful for the management of various eye disorders.

- **Sambooka (Small sized conch):**

### **Sambooka**

Sambookais traced at 5 places and in 3 conditions like Parinamasoola, Karnaroga and Yonivyapath.

- Among those 5 references, 3 are related to Parinamasoola only. - Intake of Sambooka bhasma with hot water subsides Parinamasoola quickly[73]. - Tiladi Gudika and Sambookadi Gudika are the other compound recipes useful for the management of Parinamasoola[74]. - Filling the ear with Sambookadi Taila alleviates sinus in the ear[75].

- **Samudraphena (Cuttlefish bone):**

### **Samudraphena**

Samudraphena (cuttlefish bone) is noticed at 12 places in this treatise and also observed that 75% of references are related to Netraroga only.

- It is also useful for the management of penile warts, dental caries and otolgia. -

### **Tankana**

Samudraphenadi Varti, Dantavarti, Sukhavathi Varti, Manjishtadi Vartietc. are some of the important collyrium recipes useful in corneal opacity, corneal ulcer, cataract and pterygium respectively[76].

- **Tankana (Boric acid):** - Only two references related to Tankana are traced in this work and one in the chapter of Kshudraroga and the other in Netraroga. - External application of the paste of Asphota moola mixed with Tankana results in revival of nail in whitlow[77].

### **Khati**

- **Khati (Chalk):** - Only one reference related to Khati is traced and that too in the chapter of Netraroga. - External application (Bidalaka) of the paste of Gimirrit (Gairika), Chandana, Nagara, Khatika (chalk) and Vacha restores normal vision to eyes[78].

## Conclusion:

- Though the word 'Rasa' is having several meanings viz. Rasa Dhatu (the first one among the 7 body tissues), Swarasa (fresh juice), Nava Rasa (one among the literature), One of the food substances, Parada (mercury) etc.; in the context of 'Rasasastra', one can take the meaning of Rasa as mercury only. Rasasastra means the science deals with mercury and other metallic substances, and their utilization in the therapeutics. - Man started using the metals gradually after Neolithic age i.e. since metallic age, for different purposes. Initially he used the metals bronze and copper, for making vessels and other instruments used for hunting animals, cultivation, fishing etc. Gradually he learned to utilize the metallic substances for the external medicine. After some thousands of years, man learned the techniques of using metals as internal medicine. - During Samhita period, the materia medica of Ayurveda mainly depends on herbs only. The metals were used mostly for external medication and few references indicate that they were used for internal administration. - The process of making the metals into Bhasmas was not known at the time of Samhita period. During the 6th century AD Rasa Siddhas had demonstrated some miracles with metals, to show their specialty in the society. Hence the people were attracted by them and they showed interest for the development of Alchemy. It was known from the works of 8th, 9th and 10th century AD authors, that the metals were used internally. By that time people knew the techniques of Sodhana and Marana of different metals. - Chakradatta, one of the best Ayurvedic therapeutic compendiums of medieval India was written by Chakrapani during 11th century AD. - The whole treatise contains 79 chapters and composed treatment part of all the eight branches of Ayurveda in 4869 verses. It also covers Panchakarma therapeutic procedures as well as preventive measures. - On a critical study, it is identified that Chakrapani has incorporated as maximum as 33 metals and minerals in the formulary along with plentiful of herbs and animal products. - Among all the 33 metals and minerals, the top 10 positions of these metals and minerals in their replication number is as follows: Loha (59), Manahshila (41), Sankha (31), Gairika (31), Talaka (26), Mandura (26), Shilajatu (22), Parada (19) Gandhaka (18) and Kasisa (9). - These metals and minerals are identified in 54 out of 79 chapters of this compendium. It clearly shows that Chakrapanidatta has a clear vision regarding the advantages of incorporating newer drugs to the existing materia medica. - Most of the drugs related to Rasasastra have been traced in this treatise except Zinc. - Purificatory as well as incineration techniques of metals have been comprehensively documented by the author in this compendium. - Incorporation of newer herbs such as Amlotaja, Aruna Tanduleeyaka, Abha, Kesaraja etc.; insertion of maximum number of metals and minerals in comparison with other previous medieval works, method of preparation of Rasaparpati, inclusion of Ksharasutra along with its preparation for the management of ano-rectal problems suggests that Chakrapanidatta has definitely contributed for the advancement of science in every aspect in general and Rasasastra, the iatrochemistry of Ayurveda in particular.

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